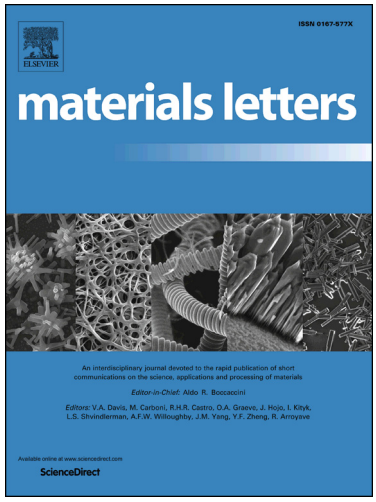

Effect of deformation path on texture and tension properties of submicrocrystalline Al-Mg-Si alloy fabricated by differential speed rolling

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Effect of deformation path on texture and tension properties of submicrocrystalline Al-Mg-Si alloy fabricated by differential speed rolling

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Abstract

The work investigated the effect of deformation path on texture and tension properties of submicrocrystalline Al-Mg-Si alloy sample processed by differential speed rolling (DSR). DSR was performed on the present samples rotated between passage utilizing three paths, such as no rotation, rotations along the transverse and rolling axes toward deformation direction in order to understand the roles of the different characteristics of macro-shear. When both no rotation and rotation along the transverse axis were applied, high strength but low ductility would be obtained due to the presence of fine grains together with lamellar bands. A good combination of strength (~312 MPa) and ductility (~7.4 %) was attained by means of rotation along the rolling axis, giving rise to the conjugation of macro-shear bands. This was explained in relation to the interpretation of recrystallization texture components.

Keywords: Al-Mg-Si alloy; Differential speed rolling; Deformation path; Texture; Tension properties

1. Introduction

Submicrocrystalline (SMC) metallic materials whose grain size was below ~1 μm have been known one of the promising candidates for a variety of industrial applications because of their superior mechanical properties to their microcrystalline counterparts [1]. As reported earlier [2,3], they could be fabricated through severe plastic deformation (SPD) imparting intense shear strain. Among these methods, differential speed rolling (DSR) where different speeds for the upper and lower rolls were controlled was reported to be desirable for achieving the formation of submicrocrystalline structure which was influenced by the deformation variables, such as roll speed ratio, deformation number, temperature, and route, etc. [4,5].

According to the current research reported by Polkowski et al. [4,5], two deformation variables, such as roll speed ratio and deformation path, played an important role in affecting the formation of SMC structure. It was well established that an increase in roll speed ratio imposed the appreciable amount of shear strain required for grain reduction unless the severe segment on the sample surface would take place. Recently, Kotiba and Ko [2]